Results from a Wetlands GNSS-R Aircraft Campaign

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Methane is ~20X stronger per kg than carbon dioxide as a greenhouse gas on 100-year timescales, with the greatest contribution to atmospheric methane coming from wetlands. However, this contribution carries the largest uncertainty among all atmospheric methane sources. Methane is produced in wetlands primarily through the anaerobic metabolism of biomass in inundated areas. Despite a number of various remote-sensing instruments, the global characterization of wetland extent and dynamics carries the largest uncertainty when applying global wetland models.

A global map of inundated areas with high spatial and temporal resolution may help reduce the uncertainty in the wetland contribution to atmospheric methane. The aircraft experiments reported here are designed to assess the spatial resolution GNSS-R observations provide from both aircraft and spacecraft platforms, along with a quantitative assessment of the impact vegetation has on those observations.

The flight data were collected on 3 separate epochs. The first was a single, few-hour flight performed on Dec 13, 2016, which focused on collecting a variety of terrain types including the ocean but focusing mostly on lakes. Lake data represents the simplest inundation scenario – open water without vegetation. The second data epoch was Jan 25, 2017 consisting of two ~four-hour fights over a large number of coastal wetlands, wildlife preserves, soil-moisture stations, and Ramsar sites in California. The third data epoch was May 2, 2017 around the Caddo Lake Region on the TX/LA border. One of us (CC), separately toured this region that day by boat to collect in situ data on inundation and tree density. All data collection efforts appeared to have been successful.

We processed the raw sampled data from the direct signal through a software receiver, and then applied the model to a down-looking antenna H and V-polarized patch antenna, forming Delay-Doppler map each 20 msec. These were combined incoherently each 0.1 sec and the peak DDM power was extracted. These received power observations were noted along with the specular reflection points for further analysis. Using these data, we will present results showing the extent to which GNSS signals can penetrate dense vegetation to sense underlying inundation.